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DURIP 09) AN ATOMIC OXYGEN FLUX MONITOR FOR USE IN THE SEARCH FOR NEW AND BETT

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Final Report

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Molecular beam epitaxy (MBE) of oxides and nitrides has emerged in the past two decades as an important application of the powerful MBE synthesis approach, with its ability to achieve controlled layer-by-layer growth on the atomic level. In the case of oxides and nitrides, one problem has been the lack of actively controlled in-situ sources of atomic oxygen and nitrogen suitable for MBE application. (Full Report attached)

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Final Performance Report
AFOSR DURIP

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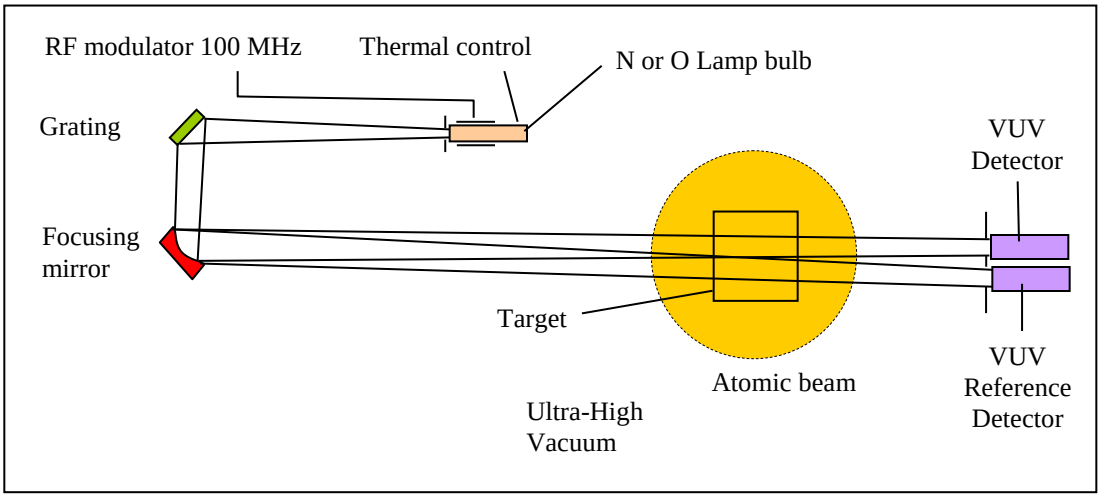
M. R. Beasley, PI
Stanford University

Project Title: Atomic Oxygen (AO) and Nitrogen (AN) In-situ Flux Sensor

Molecular beam epitaxy (MBE) of oxides and nitrides has emerged in the past two decades as an important application of the powerful MBE synthesis approach, with its ability to achieve controlled layer-by-layer growth on the atomic level. In the case of oxides and nitrides, one problem has been the lack of actively controlled in-situ sources of atomic oxygen and nitrogen suitable for MBE application. The goal of this DURIP was to work with a commercial company to conceptualize, design and build an actively monitored (i.e., quantitatively detected) and controlled (i.e., feedback stabilized) source of atomic oxygen and nitrogen fluxes. Atomic Absorption Spectroscopy is a well-established method for the detection of atomic species in the earth's atmosphere at altitudes between 50 and 200 km. Working with *Resonance LTD*, which is expert in these space based systems, our goal was to miniaturize and adapt this approach to a UHV MBE environment.

A block diagram of the new instrument is pictured below. A modulated source of VUV atomic emission lines from an oxygen or nitrogen lamp is filtered by a grating monochromator, passed through the growth region and detected. The detected signal is a measure of the atomic flux at the growing film, free from other VUV emission sources within the system and non-absorbed lines, and is available for feedback control. The non-absorbed lines to the reference detector permit correction for variations in the atomic lamp source intensity. The major technological challenge is the VUV nature of the relevant spectral lines in the case of oxygen and nitrogen. A *LabVIEW*™-based data acquisition system is used for for flexible display analysis and storage of data.



Block Diagram of the Resonance ONAMS-UHV Atomic Absorption System for in-situ measurement of atomic species in MBE systems

A complete system was delivered to Stanford at the end of this project. The system met the specified performance goals. The system was mounted on our previous Molecular Beam Synthesis system and applied to the growth of epitaxial films of doped tungsten oxide, which we had shown earlier are extraordinarily sensitive to oxygen content. Unfortunately, this application never matured due to programmatic changes and some minor damage to the instrument by us. However, the instrument is now available for use with the new MBE system that will be delivered and installed in our lab at the end of March 2016.